RFID TIRE LABEL

FIELD OF THE INVENTION

The invention relates to labels. More specifically it relates to tire labels with RFID tags.

The inventive RFID tire label is attached with a pressure sensitive adhesive to a tire (inside or outside) for use in automating the collection of information through the wheel mounting and final assembly processes. This RFID tire label design preferably uses an open mesh of woven polyester filaments for the face stock.

Background of the Invention

Most tire labels whether they are tread labels or smart labels with RFID inserts are made from solid label films extruded from polymers such as polypropylene, polyethylene, polyvinyl chloride (vinyl), polyolefins and copolymer blends. The problem with these solid films is they can be stiff and non-conformable. Continuous exposure to ultraviolet radiation (sunlight) and high/low temperature extremes (thermal cycling) breaks down the film, resulting in loss of tensile strength, cracking, crazing, staining, and discoloration. Loss of plasticizers within the film also leads to a reduction in flexibility and conformability, the label becomes hard and brittle.

The use of multiplayer films, primers, barrier layers and adhesive constructions is sometimes used to resist migration of mobile ingredients such as oils, resins, tackifiers, or plasticizers form within the rubber based adhesive layer that exhibit a high affinity for polyolefin face stocks. This migration of mobile ingredients into the label film often manifests itself as swelling or hardening of the face stock which, in turn, leads to wrinkling of the label constructions and general loss of adhesion.

Barrier films and primer layers are sometimes used between the back of the label film and adhesive layer to prevent discoloration and loss of adhesion caused by migration of low molecular weight mobile components such as waxes, extender oils, lubricants, anti-reversion coagents, sulphide resins, and plasticized sulfur from within the tire into the label face stock and adhesive as the tire ages. This diffusion process can be restricted or influenced by several factors such as ambient temperature, humidity, concentration of filler contaminants in the rubber tire compound, the chemical make up of the label face stock, the chemical make up of the pressure sensitive adhesive, the thickness of the label face stock, and the thickness of the adhesive. Higher ambient temperature and

humidity levels generally accelerate the diffusion process. Thus, it is desirable to have a label face stock construction that restricts or prevents this diffusion process.

Typical tire labels may utilize multilayer face stocks in combination with barrier layers, but the additional processing steps and curing of barrier components can make these constructions expensive to manufacture. To prevent diffusion of mobile low molecular weight components into the adhesive and label face stock the barrier layer must be designed to meet one or both of the following conditions:

- The barrier layer must be comprised of a material that is dissimilar in terms of polarity. Since diffusion is promoted with materials of like chemistry, a dissimilar material will inhibit diffusion. For example, a non-polar material such as oil will not diffuse well through a solid polar film such as polyester (PET).
- The barrier layer is comprised of a polymeric material that has specific structure such that migration of low molecular weight materials is restricted due to size exclusion. A highly branched polymer such as a solid polyester film may prevent component migration.

The problem with solid polyester film is high stiffness. This type of label film is not suitable for labeling a tire surface because it is not flexible and does not conform well to surface irregularities such as raised lettering, serrations, vent ports, and deep tread patterns. High stiffness prevents a good adhesive bond to build between the label and tire surface, thus, the PET label is likely to lift and fall off or catch on something and peel away.

SUMMARY OF THE INVENTION

Embedded RFID tags have yet to be developed, tested and proven as a reliable and durable method of tracking tires. A "smart label" with an RFID insert is a readily available user-friendly technology for tire traceability. The label provides protection for the IC and antenna from damage and abrasion. The label adhesive over the RFID insert provides an additional seal to protect the insert from fluids such as tire lubricants.

Stiff label films tend to lift from the tire surface and offer limited adhesion due to non-conforming solid films. In the present invention, a flexible open polyester mesh provides excellent label conformance and adhesion. Low stiffness allows the label to quickly conform to tire surface irregularities such as raised lettering, serrated patterns, vent ports and deep tread patterns. The adhesive flows in between the open mesh filaments

provides a stronger mechanical adhesive bond because there is greater surface area around the filaments for the adhesive to attach to than with a solid label film.

Prior art tire labels have weak adhesive bonds and label staining occurs due to outgassing and migration of low molecular weight tire components. In the present invention the open mesh breathes and resists plasticizer migration and outgassing. A higher coat weight of adhesive maintains a more secure bond at the adhesive-film interface as plasticizers and other low molecular weight additives within the rubber tire compound migrate to the tire surface and into the adhesive and label.

As label tags age they can become brittle, losing their tensile strength. Thus, prior art tire labels often tear when removed. In the present invention a polyester mesh face stock is stronger and more tear resistant than a plastic coated cotton fabric or softer conventional tire label films such as vinyl, polyethylene and polypropylene. Thus, it can easily be removed in one piece from the tire surface without tearing.

Brief Description of the Drawings

Figure 1 is a cross sectional view of an inventive tire label.

Figure 2 is a top view of a die cut label web.

Figure 3a is a cross section of an alternative embodiment of the inventive tire label before being attached.

Figure 3b is a cross section of the alternative embodiment of Figure 3a after being adhered to a surface.

Figure 3c is a cross section of the inventive tire label of Figures 3a and 3b showing adhesive flow.

Detailed Description of the Invention

Radio frequency transponders (RFID tags) generally include an antenna and integrated memory circuit with read/write capability used to store digital information, such as an electrically erasable programmable read only memory (EEPROM) or similar electronic device. Active RFID tags include their own radio transceiver and power source, for example a battery, and are generally sealed within a molded plastic housing. Passive RFID tags are energized to transmit and receive data by an electromagnetic field and do not include a radio transceiver or power source. As a result, they are small and inexpensive with limited range, resolution and data storage capacity. Passive RFID tag inserts used in the Automatic Identification Industry are typically laminated or inserted

into a paper or plastic label stock backed with pressure sensitive adhesive for applying the printed label to a carton, pallet, airline baggage, parcel or other article to be tracked. These labels are commonly referred to as "smart labels".

The inventive label 2 comprises a label face stock 10 preferably made form a woven polyester mesh and coated on one side with a rubber-based pressure sensitive adhesive 4 for attaching the RFID insert 16 to a tire. The label 2 may be oversized to seal and bond to the tire around the RFID insert 16, providing a tight, secure bond resistant to abrasion and fluids. The label face stock 10 may be polyester, nylon, cotton or other woven mesh of organic, synthetic or blend of filaments 12 with low stiffness properties for conforming to a tire surface. The label face stock 10 can be made of a mesh, woven or knit fabric. Mesh refers to openwork fabric, woven refers to interlaced network of threads, and knit refers to fabric made by intertwining threads in a series of connected loops. Preferrably, the fabric is a mesh. The preferred filaments 12 are 64-micron diameter and the preferred fabric has a thread count of 156 threads per inch to provide an optimum adhesive bond yet minimize adhesive flow through the fabric 10. Thread count, diameter and weave pattern may be changed to produce the desired thickness and flexibility for the label.

The label 2 may be dyed, pigmented or printed to any color or pattern. The label2 may be printed with indicia including text, graphic or bar codes. The underside of the face stock 10 may be coated or treated with a primer (not shown) to improve the interface bond with the adhesive.

The label face stock 10 can be capped or laminated with another film, coating or woven material 18 for additional stiffness, printability or prevention of adhesive flow through the label face stock 10. The label face stock 10 could also be made from a more tightly woven pattern of filaments 12 for a closed mesh design that would prevent adhesive bleed through and enhance printability.

Adhesive 14 thickness preferably is between 3-6 mils, but thickness can be more or less depending upon the desired adhesion level. Additional adhesive 14 may be applied to the back of the RFID insert 16 so that it provides a better bond for the insert to the tire surface 26. Other methods of label attachment may be used including heat seal, uv-cured, epoxy, acrylic based pressure sensitive adhesives or blends of polymers and/or copolymers.

A release liner 20 may be used to protect the adhesive 14 prior to use. The tire labels 2 can be manufactured in a roll or fan folded configuration. The label 2 configuration can be provided with singulated labels on the web, or in a continuous web (non-singulated) to be manually or automatically cut.

Labels preferably are approximately 4" x 2", but are not limited to this size. Preferrably, the labels are die cut labels 22. Each label 10 may have a dry pull-tab 24, i.e. an area without adhesive along one edge to facilitate easy removal. Pull-tabs 24 may be readily identified by a printed arrow, mark, color or other method of visible detection.

Each label attached to the outer surface of a tire 26 can contain a single RFID insert 16, or multiple inserts. Smart labels 2 can be manufactured with RFID inserts 16 embedded in the label, or RFID inserts 16 can be introduced to the label 2 at the time it is applied to the tire surface.

The use of the inventive woven mesh label face 14 is not limited to smart labels with RFID inserts 16. A fabric face stock 10 may also be used for other tire labels including tread labels, retail labels, high point labels and match mount labels.

Over time, some rubber based pressure sensitive adhesives will develop a strong enough bond to the tire surface that the separation interface will either be cohesive (separation within the adhesive layer) or adhesive (separation at the label-adhesive interface). This is a common problem with solid label films such as polypropylene, vinyl and polyethylene. An alternate embodiment, as shown in Figures 3a – 3b, addresses these problems by utilizing an intermediate open mesh material located between the solid film label (cap) and tire. The mesh materials will unique benefits over a solid film such as greater surface area, keying of the adhesive, and adhesive mobility to promote adhesion.

To enhance adhesion of the label to a tire sidewall having surface irregularities, such as serrations, raised or depressed lettering, vent ports and tread. Extra adhesive is pushed through the intermediate open label stock layer 10 to better contact the recessed areas of a tire surface. The label stock 10 can be made of a mesh, woven or knit fabric. The filaments 12 have a greater surface area that has exposed to the adhesive as compared to a solid film. As the thread count increases, the adhesive surface area also increases.

A further benefit of this embodiment is when adhesive 14 flows through the weave between the filaments 12, there is added resistance which increases the pull strength of adhesive on the label and reduces cohesive failure within the adhesive layer 14.